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THE STEAM-ENGINE.

The Steam-Engine. By G. C. V. Holmes. (London: Longmans, 1887.)

THIS treatise is intended as an elementary text-book for technical students. In many respects it fulfils its purpose, at least better than any book of moderate size with which we are acquainted. It is clearly written; its arrangement, if not the best possible, is orderly; it is so far practical that problems arising in the actual design and use of steam-engines are not ignored, but attacked in a sufficiently elementary way; and the *rationale* of processes involved in the use of steam is explained adequately and correctly on the whole. The woodcuts represent fairly good examples of construction, with the exception of one or two, like those of the injector and exhaust-ejector, which are antiquated, and one or two others so bad that they are obviously mere imaginary sketches. Nevertheless the book fails of being what a really good elementary text-book of the steam-engine might easily be—what, indeed, anyone of Mr. Holmes's competence would make it, if some experience in teaching had shown him the needs and difficulties of engineering students. It is a little to be feared that Mr. Holmes's book is marred by an attempt in part to adapt it to the requirements of some existing examinations on the steam-engine, which are more scrappy and less scientific than the worst of existing text-books. If only a really adequate practical and elementary text-book were written, it would control the examinations instead of needing to be adapted to them.

The treatise includes the mechanics, the thermodynamics, and rules for the design of steam-engines. The portions included under the last head are by far the weakest portions of the book. The scattered discussions of the strength of some portions of engines and boilers are too vague and general to be of practical value. The rules for the strength of fly-wheels at p. 246, and that for area of steam passages at p. 204, are examples of the kind of useless rules which stop short of encountering any one of the actual difficulties of ordinary designing. It is just these portions of the book which seem designed to meet the exigencies of a student cramming for an examination, and the book would be improved by their omission. An elementary treatise on the steam-engine might well leave questions of design on one side, and confine itself to a descriptive account of engines and boilers, with theory enough to explain the actions involved. But then it is neither necessary nor useful in such a treatise to introduce elementary physics and mechanics. A technical student may be assumed to know elementary science. "I have not assumed," says the author, "the slightest acquaintance on the part of the reader with the sciences of heat and motion, and have consequently devoted many pages to the explanation of such parts of these sciences as are necessary for the proper understanding of the working of engines." Hence we find a chapter on the nature of heat, including a discussion of the melting of ice, and the graduation of thermometers. There are definitions of mass, weight, force, and velocity, and arithmetical examples of the laws of motion. Surely

all this would only be justifiable in an age when elementary books were scarce and dear. An ordinary student finds it a tiresome obstruction, when the way to the subject of the book is barred by such repetition. On the other hand, a brief but clear and critical account of the methods by which Regnault determined the fundamental constants for steam would have been very useful. It would have shown both the meaning of the terms used, and the probable trustworthiness of the determinations. In place of this, we find only verbal definitions and formulæ.

The thermodynamical portion of the book is probably its best and clearest part, and that in which it is most in advance of any quite elementary book of a similar kind. It must be understood that in criticizing this portion we do not ignore the fact that the author has done a service to elementary technical students.

On p. 67 a diagram is copied from Maxwell, and called a diagram of isothermals of dry saturated steam. It has escaped the author that for dry saturated steam there is no isothermal. At a point in the curve, say at 212° , the steam is saturated: on one side of this it is a mixture of steam and water, or conventionally wet steam; on the other side it is superheated steam. The saturation curve so useful in steam-engine calculations is nowhere mentioned. Further, in any modern treatment of the steam-engine it ought to be recognized that the engineer is always or almost always dealing not with dry saturated steam but with wet steam. The algebraical expressions for the total heat, &c., of wet steam should be introduced along with those for dry steam. Curiously, nowhere in this book can we find an expression for the latent heat of steam, though no quantity is so often required. The total heat is given, and so the latent heat can be inferred, but surely the ordinary approximate expression for latent heat is also useful.

In Chapter III. the theory of perfect engines is given. Following the precedent of treatises of wider scope, the author begins with the laws of expansion of permanent gases. Next the theorem about a reversible engine is given, but in a form in which it is restricted to the case of an air-engine. The efficiency of the reversible engine so obtained is afterwards spoken of as the efficiency of perfect heat-engines in general. But the independence of the result on the nature of the fluid employed is nowhere indicated. The diagram for a perfect steam-engine is given on p. 113. But no elementary student will perceive why the efficiency of this is the same as that of the air-engine, at least without explanation. The only idea ordinary students get from the theorem about the Carnot engine is that the efficiency of *any* engine is proportional to the range of temperature in the cylinder. In the case of the actual steam-engine this is so wrong as to be nearly the reverse of the truth, and the misconception is hardly anywhere adequately guarded against. It is very doubtful whether the Carnot engine ought to be introduced into the elementary theory of the steam-engine. An ordinary indicator-diagram can be taken, and the relation of the heat expended to the heat utilized determined. From the feed measurement and indicator-diagram the steam liquefied at the end of admission and at exhaust can be ascertained. The heat expenditure corresponding to work of admission, expansion, and expulsion can be calculated. From the

condenser measurement the heat abandoned can be found, and an estimate formed of the loss by radiation. Repeating the calculation for different degrees of expansion, and perhaps for cases of a jacketed and unjacketed cylinder, really clear notions will be formed of the relative importance of the processes going on in the engine. All this can be done in a perfectly elementary way, and the student will soon perceive that it is in the direct study of the losses of heat, and not in attempts to realize the conditions of a Carnot engine, that improvement is to be sought.

We fail to see the use of reviving the antiquated empirical treatment of Navier and de Pambour given in Chapter IV. De Pambour's equations involve so many assumed quantities that they are practically useless. The author might have remembered that contrary to de Pambour's view the friction of an engine is not proportional to the load, but very nearly independent of it.

Chapter V. deals with the mechanics of the engine. But the simplest graphic methods for finding curves of crank pin effort and acceleration are not given. The next chapter, on slide-valve diagrams, is one of the clearest and most useful in the book.

In Chapter XI. the very difficult question of cylinder condensation is treated on the whole clearly and with insight. But the obscurities of this difficult part of the explanation of the steam-engine are, as might be expected, not quite removed. The author probably attaches much too great importance to radiation from the cylinder sides to the steam, and too little to conduction from the cylinder sides to the water lying on its surface. The following passage will certainly puzzle a student:—

"The second cause—excess of condensation over re-evaporation—is a most fruitful source of waste, and should be most carefully guarded against. It results in the continuous accumulation of water in the cylinder, and consequently causes an amount of waste which goes on increasing with each stroke."

Of course, if the accumulation is continuous the cylinder must get full, which is impossible. In steady working, initial condensation must exactly equal re-evaporation and water carried mechanically to the condenser. Priming and condensation during expansion may for the argument be neglected. What is prejudicial is not excess of condensation over re-evaporation, but retention of water in the cylinder after exhaust.

THE ANIMAL ALKALOIDS.

On the Animal Alkaloids, the Ptomaines, Leucomaines, and Extractives in their Pathological Relations. By Sir William Aitken, Knt., M.D., F.R.S., Professor of Pathology in the Army Medical School. (London: H. K. Lewis, 1887.)

A Treatise on the Animal Alkaloids, Cadaveric and Vital; or, The Ptomaines and Leucomaines chemically, physiologically, and pathologically considered in Relation to Scientific Medicine. By A. M. Brown, M.D. With an Introduction by Prof. Armand Gautier, of the Faculté de Médecine of Paris, &c. (London: Baillière, Tindall, and Cox, 1887.)

THE advancement of modern chemistry has increased our knowledge of the alkaloids occurring in the vegetable kingdom—bodies which are of great import-

ance both in a therapeutical and a toxicological aspect. Since the year 1872, a new mode of natural origin of alkaloids has been discovered, viz. from animal sources, and the knowledge and investigation of these bodies have proved of great service in the study of both physiological and pathological chemical processes.

Ptomaines were first discovered in decomposing animal tissues, as their pseudonym of "cadaveric alkaloids" implies. Their presence in these dead tissues introduced a new factor in the *post-mortem* search for poisons in suspected cases—a factor, however, the importance of which has been somewhat exaggerated. A more important result of their discovery has been the explanation of the cases of poisoning by decayed animal foods, such as sausages, tinned and putrid meats, in which they have been found.

Further researches have, moreover, brought to light the fact that similar bodies of an alkaloidal nature may be produced within, and by, the living organism. In this case they may be considered as of "vital" origin, the products, that is, of the metabolism of protoplasm; or they may, in some cases, be the result of the decomposition of albuminoid bodies: in both cases, the term "leucomaines" has been used to designate them. A leucomaïne—peptotoxin—has, for example, been found by Brieger as a product of artificial peptic digestion; another has been discovered in the body of the sea-mussel (*Mytilus edulis*), and to its presence were ascribed the symptoms of poisoning which occurred in Wilhelms-Haven, in many people who had eaten the shell-fish. These facts, of the origin of poisonous alkaloids by the decomposition of albuminoid bodies, and also in the living animal tissues, open out a wide field of research in pathology, and have perhaps led to more speculation than our present knowledge warrants.

The two books before us deal with the whole subject of poisonous alkaloids. Sir W. Aitken's small work owes its origin to an introductory lecture delivered by him at the Army Medical School at Netley. It is chiefly a short *résumé* of the work done on the subject. The second part of the *brochure* will be found of interest to medical men, as it gives the direction in which modern thought is tending with regard to the part played by poisonous alkaloids in the production of disease. The conclusions drawn can, in the present state of our knowledge, be considered merely as suggestions: many more facts must come to light before the rôle played by the "vital" alkaloids in pathological processes can be adequately, or even reasonably, discussed.

Dr. Brown's work is of a more ambitious nature, and purports to be a treatise on the subject of animal alkaloids generally. After commencing with a short history of the subject, the author proceeds to give an account of the methods for extraction of the alkaloids, and of the chemical and physiological properties of ptomaines; the "vital" alkaloids, leucomaines, being treated in a similar manner. The account of the methods of extraction might, we think, be made more practical by being considered a little more fully, as it is to this part of the book that workers in this field will turn for information.

Of the chemical and physiological properties of these alkaloids, a fairly complete account is given: our knowledge of these properties is, however, up to the present so imperfect, that the researches carried on during the